Commentary

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SCIENTIFIC CONTRIBUTION

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Continued Adverse Trends in Coronary Heart Disease Mortality among Blacks, 1980–91

SYNOPSIS

AN ABRUPT DOWNTURN in mortality rates from coronary heart disease occurred in the United States in the mid-1960s, and for the next decade all four major sex-race groups experienced virtually identical rates of decline. Beginning around the mid-1970s, however, trends for blacks and whites began to diverge, with a deceleration in the annual fall in rates for blacks. The recent release of mortality data extending through 1991, with correction of the denominator estimates in the 1980s using the 1990 census, demonstrate a striking linearity of this trend over the entire decade.

In 1989, for the first time since the category of coronary heart disease has been recorded in vital statistics, the age-adjusted death rate for it among black men exceeded that of whites. As a result of the divergent trends among men, an excess of 4,000 deaths of blacks were recorded in 1991 alone. Among women, coronary heart disease mortality was higher

among blacks at the beginning of this period, and the average annual percent decline was only two-thirds that of whites. As a result, the absolute mortality gap between blacks and whites steadily increased from 19 to 33 percent (1980 to 1991). This study indicates that the factors that have led to the decline in coronary heart disease have not influenced all demographic groups equally over the last decade.

Coronary heart disease (CHD) is the leading cause of death in the United States for all major demographic groups, despite remarkable declines in the last three decades. It is also known that there is a divergence of the decline in death rates among blacks and whites since the mid-1970s *(1)*. However, the relative frequency of CHD in blacks compared with whites has been a subject of ongoing controversy. As repeatedly pointed out over the last two decades, the coronary risk profile among blacks should translate into substantially higher mortality (*1–3*). Surprisingly, among men at least, lower CHD death rates for blacks compared with whites were consistently recorded in both epidemiologic studies and vital statistics reports through the 1970s (*1–7*). Some investigators have invoked protective mechanisms of a biological nature to explain what were thought to be paradoxically low rates *(8,9)*. Since the 1980s, it has been generally recognized that CHD is also common in blacks and that case fatality rates are high (*3,10,11*). However, CHD mortality in black men has never exceeded that of whites in the country as a whole. In this report we describe the final updated CHD mortality patterns for the 1980s through 1991 with use of the 1990 census data and demonstrate the race differential in the secular trend of CHD mortality.

White men experienced the most rapid rate of decline...

Methods

Data sources and definitions. Age-adjusted CHD mortality rates were calculated at the National Center for Health Statistics (NCHS). Updated data for 1985–90 (*12*) and for 1991 (*13*) were derived from published literature, and data for 1981–84 were obtained from Christopher Sempos, PhD, of the National Center for Health Statistics (NCHS) (personal communication). Age-adjusted rates were computed by the direct method using the total U.S. population of 1940 as the standard. Using the 1990 census data, adjusted rates for the 1980s were updated based on intercensal population estimates (*12*). Intercensal estimates were prepared for the 1960s and 1970s as well to correct the "error of closure," that is, the difference between the estimated population at the end of the decade and the census count for that date.

For national mortality statistics, every death was attributed to one underlying condition based on information reported on the death certificate and the international rules for selecting the cause of death. Succeeding revisions of the International Classification of Diseases (ICD) were used in different periods in this study: the Seventh (ICD-7), 1958–67; the Eighth (ICD-8), 1968–78; and the Ninth Revision (ICD-9), 1979–present. The rubrics used to define CHD over this period were as follows: No. 420 for ICD-7, Nos. 410–413 for ICD-8, and Nos. 410–414 for ICD-9. Since the coding rules were not strictly comparable across the ICD revisions, the racial comparisons in this report were restricted primarily to each separate ICD era, with particular emphasis on the 11-year span from 1980 to 1991. In this period, ICD-9 was applied throughout and the accuracy of the coding for CHD may have improved, both as a result of coding changes and newer diagnostic techniques. Furthermore, data on blacks have been separated from other nonwhite populations in the NCHS surveillance systems during the entire ICD-9, which was not always true for the earlier revisions.

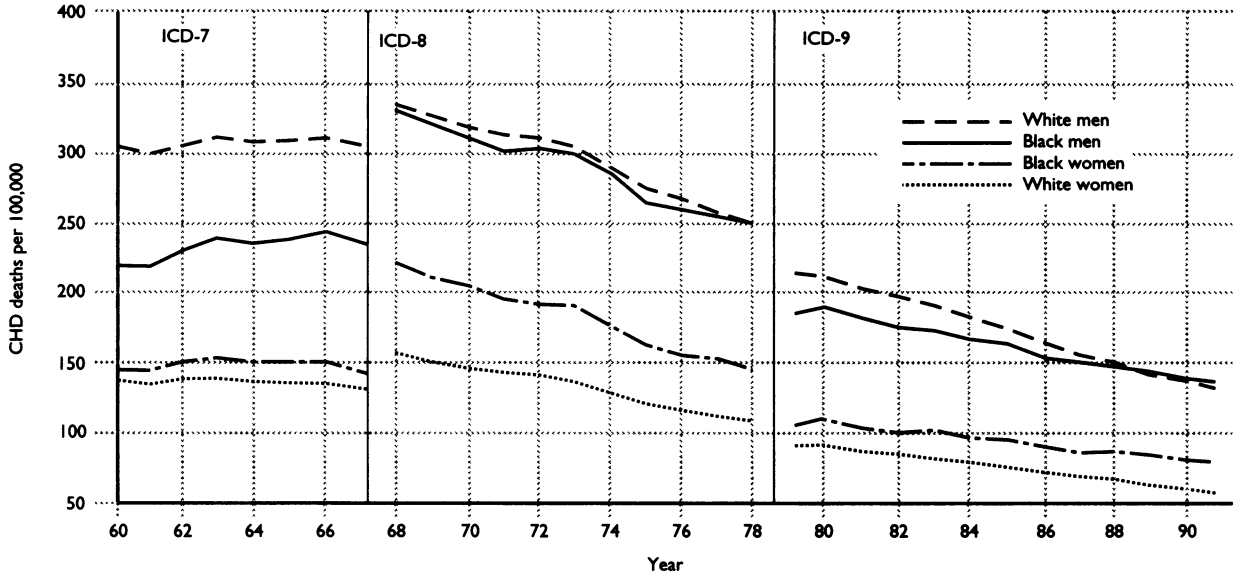
Statistical analyses. Linear regression was the primary model used in this report to test and display the secular trends, and to calculate the average absolute rates of change in CHD mortality from 1980 to 1991. The absolute rate of change was expressed as rate of change per 100,000 population per year. An additional log-linear model, which assumes that there is a constant proportional or relative change, was also used to calculate the average annual percent change. All racial comparisons were made within the same sex. The slopes of two regression lines—or the rates of change—were compared by testing the interaction term "race × years."

Based on the average absolute rate of change, we calculated the projected CHD mortality for blacks for each specific year assuming blacks had a speed of decline equal to that of whites since 1980. For example, projected CHD mortality for blacks in 1987 was as follows: Mortality among blacks at 1980 – [(slope of mortality changes among whites from 1980 to 1991) × 7 (years)]. The projected mortality rate times the observed number of deaths (blacks) divided by the observed mortality rate (blacks) is the projected number of deaths among blacks. The difference between the observed and projected number of deaths at specific years expresses the absolute excess number of deaths among blacks which resulted from the slower rate of decline.

Results

CHD mortality in the three decades of the decline. Since the mid-1960s, age-adjusted CHD mortality has declined

Figure 1. Secular trends in age-adjusted coronary heart disease (CHD) mortality, United States, 1960–91



continuously for all four sex-race groups (fig. 1). The apparent increase for the period 1968–78 was a direct result of the inclusion of "other hypertensive heart disease" (ICD-7 Nos. 440, 441, 443) as a component of CHD following the introduction of ICD-8. Since hypertensive heart disease is considerably more common among blacks than whites, the associated upward shift in mortality was more prominent in this group. Following the introduction of ICD-9 in 1978,

Figure 2. Fitted regression lines for age-adjusted coronary heart disease (CHD) mortality, United States, 1980–91

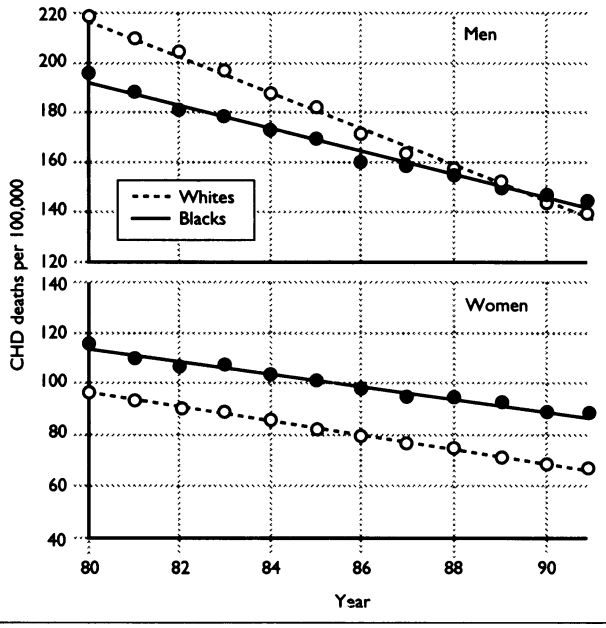


Table 1. Age-adjusted mortality rates[1] per 100,000 population for coronary heart diseases, average absolute change and percent change in annual rates by sex and race, United States, 1980–91

	Men		Women	
Years	Whites	Blacks	Whites	Blacks
1980	218.0	196.0	97.4	116.1
1981	209.4	188.4	93.3	110.4
1982	203.5	181.4	91.0	107.3
1983	196.8	179.3	89.1	107.6
1984	188.0	173.0	86.0	103.2
1985	182.1	170.4	82.9	101.6
1986	171.3	160.3	79.5	97.8
1987	163.3	158.4	76.8	94.5
1988	157.6	155.1	74.7	94.1
1989	150.2	152.2	71.0	92.3
1990	145.3	147.1	68.6	88.8
1991	139.7	144.5	66.4	88.3
	Absolute average annual rate of change			
1980–91	-7.32	-4.61	-2.82	-2.46
95 percent CI	7.00,-7.64	-4.19,-5.03	-2.73,-2.91	-2.20,-2.71
	Average annual percent change			
1980–91	-4.08	-2.71	-3.43	-2.42
95 percent CI	-3.91,-4.24	-2.52,-2.90	-3.28,-3.58	-2.20,-2.63

[1]All rates were age-adjusted by the direct method using the total U.S. population of 1940 as the standard.

NOTE: CI= confidence interval.

hypertensive heart disease was no longer included in the definition of CHD, and an obvious drop in the rates was observed. Regardless of the changes in coding rules, the decline in mortality was monotonic in the periods of both ICD-8 and ICD-9.

Racial differences in the recent decline in CHD mortality. A slower decline of age-adjusted CHD mortality has been observed in blacks compared with whites of the same sex since 1980 (fig. 2). The fitted regression lines for the years 1980–91 demonstrate the marked difference for men, and the more subtle, but visually apparent divergence for women. White men experienced the most rapid rate of decline in mortality among all the sex-race groups, and the regression lines for black and white men crossed in 1989. The difference in slopes of the two regression lines for men was statistically significant ($P < 0.001$). Although the racial difference among women was not as striking, the slope of the regression line for blacks was still significantly lower than for whites ($P < 0.01$).

The sex- and race-specific age-adjusted CHD mortality rates per 100,000 population from 1980 to 1991 are presented in table 1. In 1980, white men had mortality rates 11 percent higher than those of black men (218.0 versus 196.0, per 100,000). However, this contrast was inverted beginning in 1989, and the rates were 139.7 for whites and 144.5 for blacks in 1991. Black women had higher CHD mortality than white women throughout, with the absolute gap steadily increasing from 1980 (+18.7) to 1991 (+21.9), an increase in relative difference from 19 to 33 percent.

Absolute and relative annual rates of change in CHD mortality and their 95 percent confidence intervals were calculated and are also shown in table 1. Black men experienced about two-thirds as great a decline as did white men in rates for both absolute and percentage changes. Compared with white women, black women had 13-percent lower absolute change and a 29-percent lower rate of change. All four pairs of race differences for the two rate indicators within the same sex were statistically significant ($P < 0.001$).

Figure 4. Coronary heart disease as a proportion of deaths from all diseases of the heart, United States, 1980–91

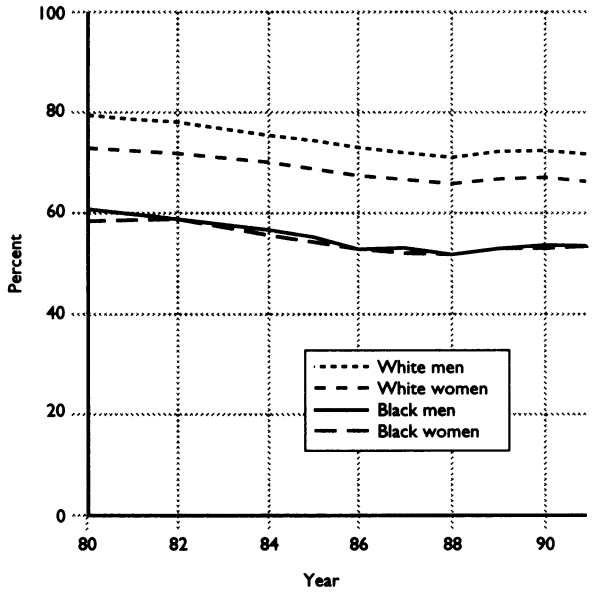
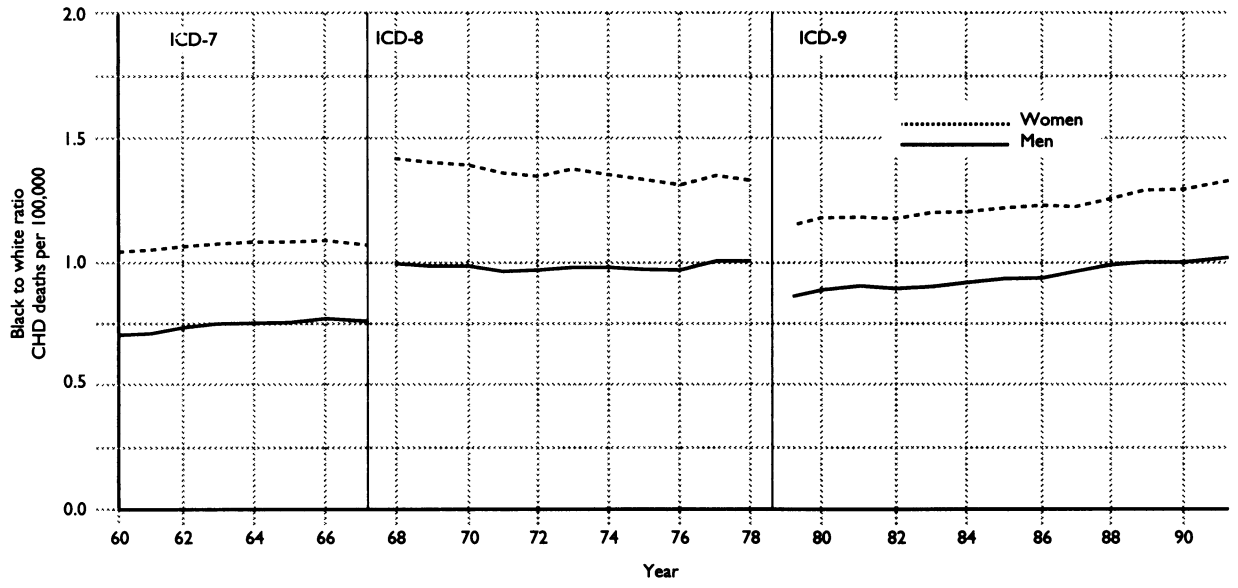


Figure 3. Secular trends in the ratio of age-adjusted coronary heart disease (CHD) mortality, blacks versus whites, United States, 1960–91



Trends in black to white ratios in CHD mortality. Black-white mortality ratios in age-adjusted CHD mortality have increased since 1960, especially in the last decade (fig. 3). The changes from ICD-7 to ICD-8 and from ICD-8 to ICD-9 were associated with substantial artifactual upward and downward shifts in the rates, and they must be viewed in that context; the lack of increase in black-white ratio during ICD-8 may represent the more rapid decline among blacks attributable to the ICD code which combined hypertensive heart disease and CHD (see Methods Section). Within the ICD 9 period, the black to white ratio for men was 0.90 in 1980, exceeded 1.0 in 1989 (1.01), and increased to 1.03 in 1991. For women the ratio increased from 1.06 in 1960 to 1.19 in 1980, and finally to 1.33 by 1991. The rate of increase in the black-white ratio appears to be similar in the two sexes over the entire study period.

Trends of CHD mortality as a component of diseases of the heart. We examined the potential existence of systematic transfer of assigned cause of death from other heart diseases to CHD, or vice versa, which might contribute to the racial differences in the CHD trends. Figure 4 displays CHD deaths as a proportion of all diseases of the heart from 1980 through 1991. With some minor fluctuations, CHD consistently accounted for 70–80 percent of deaths from diseases of the heart in whites and 50–60 percent in blacks. Although these proportions changed slowly in a nonlinear fashion from 1980 to 1991, the four sex-race curves are nearly parallel. No significant linear trends for age-adjusted mortality of heart disease other than CHD were observed in any of the four sex-race groups as well, essentially ruling out the possibility of transfers across codes (data not shown).

Table 2. Estimated excess deaths from coronary heart disease (CHD) in black men and women associated with slower decline in mortality since 1980, United States, 1987–91

Year	Age-adjusted CHD mortality (100,000 per year)		Number of CHD deaths		
	Observed	Projected[1]	Observed	Projected[1]	Excess
			Black men		
1987	158.4	144.8	20,521	18,759	1,762
1988	155.1	137.4	20,430	18,099	2,331
1989	152.2	130.1	20,243	17,304	2,939
1990	147.1	122.8	19,858	16,578	3,280
1991	144.5	115.5	19,966	15,959	4,007
1987–91	...	...	...	...	14,319
			Black women		
1987	94.5	96.4	20,549	20,962	-413
1988	94.1	93.5	20,989	20,855	134
1989	92.3	90.7	21,133	20,767	366
1990	88.8	87.9	20,713	20,503	210
1991	88.3	85.1	21,188	20,420	768
1987–91	...	...	...	...	1,065

[1]A hypothetical calculation assuming blacks had the same slope or rate of decline in CHD mortality as whites from 1980 to 1991.

Excess CHD deaths in blacks associated with the slower decline in mortality. Since blacks, especially black men, have experienced a slower decline in CHD mortality, we estimated the associated excess CHD deaths for the 5 years since 1987, expressed as the number of CHD deaths which would have been avoided during 1987–91 if the decline after 1980 in blacks had been of equal magnitude to that of whites (table 2). Black men had a mortality rate in 1987 that was 9 perecent higher than the rate projected from the 1980–91 trend in whites. This observed and projected rate difference was 25 percent of that projected in 1991. There were an estimated 4,000 excess CHD deaths of black men in 1991 alone due to the slower decline of mortality among blacks. The sum of the 5-year excess CHD deaths from 1987 to 1991 exceeded 14,300. The racial difference in the rate of the mortality decline was smaller in women, resulting in a smaller excess of CHD deaths for black women, that is, 768 for 1991 and 1,065 for 1987–91.

Discussion

In this report, we demonstrate that the slower decline in CHD mortality for blacks has resulted in a level of age-adjusted mortality for both sexes that exceeds that of whites. It appears that the era of controversy over the black disadvantage for the leading cause of death in this country has finally ended. Any attempts to reduce the black-white disparity in adult health should address forcefully the widening gap in CHD.

A number of factors could potentially have contributed to the slower rate of decline and the subsequent excess of deaths from CHD among blacks, including secular trends in the prevalence of risk factors and differential access to treatment.

Trends in the prevalence of risk factors for CHD. Available data from national surveys (*14–16*) on black : white comparisons of the major coronary risk factors are summarized in table 3. From the First National Health and Nutrition Examination Survey (NHANES-I) (1971–75) to the Second National Health and Nutrition Examination Survey (NHANES-II) (1976–80) the estimated prevalence of hypertension was generally unchanged among whites, while a modest decrease was noted in blacks (*12*). However, recent data showed that the prevalence of hypertension increased from NHANES II to NHANES III (1988–91) for black men ages 65 to 74 (*17*). Data on other age groups are not available.

Total cholesterol levels fell in all four sex-race groups from NHANES-II to NHANES-III, and the sex-specific change for low density lipoprotein cholesterol was smaller among blacks (*18*). The decrease in the percentage of persons with high cholesterol levels was similar for blacks and whites, although there appeared to be a larger decline in

Table 3. Secular trend of risk factor levels (age-adjusted) for coronary heart disease in the U.S. population, ages 20–74, by sex and race, NHANES I - III

	Men						Women					
	Whites			Blacks			Whites			Blacks		
Risk factors measured in NHANES:	I	II	III	I	II	III	I	II	III	I	II	III
Percent hypertension[1]	43.3	44.8	...	54.2	50.5	...	34.1	34.2	...	52.9	50.6	...
Percent elevated BP[2]	42.1	43.1	...	51.0	48.5	...	32.6	31.0	...	48.5	45.2	...
Mean TC (mg per dL)	213	211	205	212	208	200	215	214	205	217	213	205
Mean LDL (mg per dL)	...	139	132	...	129	127	...	134	124	...	134	127
Percent high TC[3]	25.9	24.6	19.3	25.1	24.1	16.5	28.1	28.0	20.3	29.2	24.9	20.7
Percent overweight[4]	24.3	24.9	...	25.0	27.5	...	25.0	25.2	...	44.5	46.1	...
Percent current smoker[5]	41.7	36.5	27.6	54.0	44.1	32.2	32.3	30.6	23.9	35.9	30.8	20.4
Percent NIDDM[6]	2.7	2.9	...	3.6	4.4	...	3.0	3.1	...	4.9	5.5	...

[1]Systolic blood pressure ≥140 or diastolic blood pressure ≥90 mmHg or taking antihypertensive medication.

[2]Systolic blood pressure ≥140 or diastolic blood pressure ≥90 mmHg.

[3]Total cholesterol ≥ 240 mg/dL.

[4]Body mass index ≥ 27.8 for men and ≥ 27.3 kg/m^2 for women.

[5]Data on smoking were from the National Health Interview Surveys in 1974, 1979, and 1990, respectively.

[6]Self-report medical history of diabetes. Data were from the National Health Interview Surveys in 1976 and 1979–1981, respectively.

NOTE: I, II, and III represent the First (1971–74), Second (1976-80), and Third (1988–91) National Health and Nutrition Examination Surveys (NHANES). BP=blood pressure; TC=total cholesterol; LDL=low density cholesterol; NIDDM=non-insulin-dependent diabetes mellitus.

black men and white women (*12*).

Both black men and women had much greater increases in the prevalence of overweight than did whites (*12*). Data from the National Health Interview surveys showed that the prevalence of current smoking has dropped over the last two decades to a somewhat greater extent in blacks, although the actual rates are still higher among black than white men (*12*). Substantial increases in diabetes have been noted among blacks, and it may come to play a role equal to hypertension in determining the black-white risk differential (*19*). Further study is needed to estimate quantitatively in detail the mortality trend attributable to the trends in risk factors.

Prevalence and incidence of CHD. In the Health Examination Survey of 1960–62 (*20*), prevalence rates of definite CHD, using all available clinical data, were 10.3 percent for white men, 5.7 percent for black men, 4.7 percent for white women, and 5.5 percent for black women, ages 55–64. The CHD prevalence rates based on self-reported diagnosis were 14.2, 6.0, 6.0, and 3.8 percent for the four groups in the 1982–84 National Health Interview Survey (*21*). However, Gillum has suggested that substantial under-reporting might have occurred among blacks in this survey (*22*).

Incidence data available for black-white comparisons are drawn primarily from studies in southeastern States (*5,23*). Incidence rates for CHD were consistently lower for black men than for white men and similar or greater in black women compared with white women. A report from the Multiple Risk Factor Intervention Trial (*24*) also found that the incidence in black men was about half that of whites in the usual care group. In the Hypertension Detection and Follow-up Program, however, the 5-year incidence of CHD was approximately equal in the two ethnic groups (*25*). Based on the 13-year CHD incidence data from the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study, extending through 1987, cumulative incidence rates were 24 percent for white men, 22 percent for black men, 14 percent for white women, and 15 percent for black women (*26*). Overall, it would appear that earlier data from the 1960s and 1970s showed lower incidence rates for blacks, while by the mid-1980s CHD incidence was similar for blacks and whites, suggesting that the black to white incidence ratio is increasing. Despite these considerations, it should be noted that results from the fixed cohort studies may not be directly comparable with or apply to vital statistics.

Access to medical care. A striking consistency has emerged in the studies of racial differences in access to care for cardiovascular disease (*27*). In data sets ranging from private hospitals to Medicare to the Veterans Administration, blacks are half as likely to undergo angiography with a comparable CHD diagnosis, and half as likely to have bypass surgery with similar angiographic findings (*27–29*).

For blacks, CHD death is more likely to occur out-of-hospital or in the emergency room than for whites (*30–32*). In rural South Carolina, out-of-hospital deaths accounted for approximately one-third of myocardial infarction cases of whites and two-thirds of blacks (*31*). The Community Cardiovascular Surveillance Program, conducted in 12 separate communities throughout the United States, also confirmed that both sudden death and out-of-hospital death were more frequent in blacks than whites (*32*). Black patients are thus less likely to survive long enough to receive emergency medical care and, in addition, suffer higher case

fatality after reaching a health care facility (*33–35*). Unfortunately, data on the trends in racial difference in accessing medical care and out-of-hospital death are not available.

Socioeconomic status is an important predictor of CHD occurrence and survival (*36*). The disproportionate fall in rates among upper socioeconomic groups, such as physicians, accompanied by parallel trends in risk factors, lends further support to this notion (*37–39*). The adverse trends in CHD among blacks have occurred within the setting of an overall worsening of the social and economic position of people of color in the United States. Although not directly quantifiable, it seems likely that these social trends have played a important role in the divergence of the CHD rates.

Limitations of the study. Several limitations of this study should be noted. The percent net undercount of the population in the censuses has been shown to be unequal among different sex and race groups, with the undercount rate being higher for men than for women and for blacks than for whites *(40)*. Although the long-term decline in net undercount rates from 1940 to 1990 is clear, the estimated net undercount in the 1990 census exceeded that in the 1980 census (*40*). The evaluation technique that has been used to estimate net undercount is subject to considerable uncertainty for measuring the actual population count for a given year but less variability in measuring changes in net coverage between censuses. This is attributable to the fact that many errors in the estimates are believed to be consistent across sex, race, and time and hence tend to "cancel" in comparisons (*40*).

The estimated percent net undercount in 1980 was 8.5 for black men and 2.0 for nonblack men. The corresponding rate in 1990 was 7.5 percent and 1.5 percent. Hence, the extra net undercount for 1990 compared with 1980 was only 1.0 percent in black men and 0.5 percent in nonblack men. This difference in census enumeration would translate into an overestimate of mortality by 0.5 percent—clearly a trivial effect in a trend analysis. The consistency of the long-term CHD mortality trends, the similar patterns in men and women, and the findings from the incidence studies all suggest that although the actual mortality rates may not be known with precision, the trends are real.

Death certificates are at best a crude surveillance tool. However, since blacks have higher out-of-hospital death rates than do whites and the diagnostic accuracy of death certificates is lower for out-of-hospital deaths than for those in the hospital, the coding of CHD on death certificates is less specific for blacks than for whites (*32*). No concrete evidence exists, however, to substantiate the hypothesis that changes in coding practices are the root cause of the observed trends (*32*). It should also be noted that the convention for age-adjustment in most national data involves use of 1940 as the base. The average age of the U.S. population has increased substantially over the last half century, and adjustment to 1940 deflates the real changes by weighing younger ages disproportionately. In this study, we analyzed the general pattern of CHD mortality for the four demographic groups of all ages in the entire nation. Of course the mortality trend may differ according to age groups (*3*). Further investigation on this issue is needed when the updated age-specific data are available.

Conclusions. The factors that have led to the decline in CHD have not influenced all demographic groups equally over the last decade. As the result of the divergent trends among blacks and whites, national vital statistics data shows that CHD mortality of blacks now exceeds that of whites for both men and women. Although rates continue to decline in both groups, the potential benefit of the major public health advances achieved against the coronary epidemic has not been realized among blacks as much as it has among whites.

This work was supported in part by National Institutes of Health grant No. HL46120 from the National Heart, Lung, and Blood Institute. Christopher Sempos, PhD, from the National Center for Health Statistics, provided updated mortality statistics.

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